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CLINICAL INVESTIGATION ON ACUTE CARBON MONOXIDE POISONING DUE TO EXPLOSION IN MIIKE COAL MINE FIVE YEARS AFTER THE ACCIDENT

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Clinical Investigation on Acute Carbon Monoxide Poisoning Due to Explosion in Miike Coal Mine Five Years after the Accident

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by

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Preface

The carbon explosion in the Mikawa Coal Mine of the Mitsui Miike Coal Mine Company of 9 November 1963 was the largest industrial accident after the war, causing 458 deaths at once and at the same time some hundreds of the patients with acute carbon monoxide poisoning. It was, therefore, a rare accident even speaking from the medical point of view. There have been quite a few reports on the carbon monoxide poisoned patients already, [4-7,14,16,17,18] but they are mostly dealing with rather serious cases. The reports on the mild cases are so few that they are insufficient to grasp the whole medical situation of the Miike Coal Mine Accident.

Also the carbon monoxide poisoned patients received the treatment with the workmen's compensation insurance as having the impediment at work. But because of the difficulties to determine the treatment symptom fixation, the regular relation of the patients and the doctors was broken and its solution was taken without the consultation with the physicians in charge. This is a very unusual case and there has been great confusion over it.

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Thus the Miike Coal Mine Accident not only caused us physicians to face a very interesting experience for medical studies, but raised the many problems which made us think and re-evaluate our attitude toward industrial accidents and the medical treatment for those who are involved in them.

I planned the clinical investigation to grasp the actual situation of the acute carbon monoxide poisoned cases at the point of five years after the Miike Accident. There have been some investigations done by some universities around Oomuta City and other medical specialists, but they are inadequate materials for understanding the whole situation, since a regular standard was not used because of the investigation done by many physicians. Since this investigation is done only by myself and 671 (approximately 81%) examinees were covered by it and I think it reflects the actual situation of the whole carbon monoxide poisoned cases, I would like to report its report not only as the medical studies, but also as a basic material to consider the social problems as I mentioned before.

Method of Examination

Objects of the examination: We tried to make the subjects of 829 people excluding 10 who had been already dead (as of April, 1968) out of 839, who were determined to be carbon monoxide poisoned. But because of the moves and some other reasons, we actually examined 671 people (80.9%).

The period of the examination: Made the investigation from November of 1968 until the end of April of 1969.

The method of the examination: I made the individual card for each examinee beforehand. In an individual card, the age of the

of the person who was in the accident, the place where he encountered the accident, the death rate of that place (since the density of carbon monoxide at the accident moment is not calculated, the death rate is one of the materials to deduce it), the time of the impediment of the cognition, name of the labor union to which he belongs, etc. , according to the materials made by the Mitsui Miike Coal Mine Company Hospital. Then I interviewed each case to ascertain the place of encountering the accident and if he had the impediment of the cognition, and asked the condition of his consciousness and performed the simple nerosis examination and took his blood pressure. For those who were suspected to have a mental impediment or consciousness impediment judging from the way they answered to the questions, I performed a simple examination by asking a few mental questions. I used also the reference from the diagnosis records of each one of those who were in the hospitals or going to the hospitals. For few examples, especially those who were suspected of the intermittent type, I used the reference of diagnosis records of the acute period (records of the Coal Mine Hospital and Arao Shimin Hospital). The time that I spent for the examination varies by each case, but I tried to determine the main appearance of the illness from a few minutes to 30 minutes.

The time of the impediment of the consciousness was divided from 0, less than 10 hours, 10 to 20 hours, 20 to 30 hours, more than 30 hours. The age at the time of the accident was divided from 25 or younger, 26 to 35 years, 36 to 45 years, 46 to 55 years. The youngest was 18, the oldest was 57. Those who were from 56 to 57 years were five: they were included in the group 46 to 55 years for convenience's sake.

Result

1. The condition of the time of the accident:

The numbers of the people in the shaft, the dead, the survivors, and those who were determined to be carbon monoxide poisoned at the time of the carbon explosion are indicated in the Chart 1. The number of the dead was 458 and was approximately 32% of those who were in the shaft, and most of them died due to the carbon monoxide poisoning and it was reported that those who died from burns or injury of the explosion were only 20.

表1 事故当時の被災状況

1入坑者	1403名
2死亡者	458
3生存者	945
4うちCO中毒症と認定された者	839

Chart 1. The condition of the miners at the time of the accident.

1. Those who were in the shaft
2. Dead
3. Survivors
4. Those who were determined to be carbon monoxide poisoned.

Of all the survivors, 839 (approximately 90%) were determined to be carbon monoxide poisoned, and of 830, those who had the cognition impediment were about 52%, and the rest did not experience it. The cognition impediment here means that at the time of the accident, they lost their consciousness and for a certain period they had amnesia.

Chart 2 shows the death rate by the different age groups.

The group under 25 years of age suffered a death rate of about 26%, but as the group becomes older, it suffers the higher rate; 46 to 55 years of age suffered 37%, out of five in the group of 56 to 57 years of age, two (40%) died. The death rate obviously becomes higher as the age gets older.

表2 年令別死亡率

1年令(才)	2入坑者(名)	3死亡者(名)	4死亡率(%)
25以下5	104	27	25.9
26～35	397	118	29.7
36～45	520	172	33.1
46～55	373	139	37.3
56～57	5	2	40.0
6不明	4	0	0
7計	1,403	458	32.6

Chart 2. Death rate by age.

1. Age
2. Those who were in the shaft
3. Death
4. Death rate (%)
5. or under
6. Unknown
7. Total

As for the carbon monoxide poisoning, the intermittent type is one of the interesting things. Of the carbon monoxide poisoned people, in this accident, those who showed the complete intermittence were six (approximately 1%), those who had the cognition impediment were approximately 2%. Age and the period of the intermittence don't have the tendency of having more older people as shown in the Chart 3.

表3 間歇型症例

1 症　例	2 年　令 (才)	3 間歇期 (日)
Tom.	27	12
Mar.	29	3
Mat.	36	7
N.	41	36
Tag.	54	31
H.	53	43
4 平　均	40	22

Chart 3. Examples of the intermittent type.

1. Examples
2. Age (years old)
3. Period of intermittence (days)
4. Average

2. Conspectus of the result of the examination.

Chart 4 shows the general view of the result of the examination. Those who were determined to have the organic impediments are approximately 28%, and of them, those with the intellectual impediments are the highest with approximately 25%. Those with affected character are 12%, nervous disorder is 8%, self-nervous impediment is 4%. About a half of them showed only one of these impediments. Most of them (approximately 40% of the organic impediments) were intellectual impeded. The rest showed the combination of more than two impediments, and quite a few showed intellectual impediment and affected character (about 20%), then intellectual impediment, affected character and nervous disorder (approximately 13%) combined. Those who put down nervous disorder are about 6% of the whole. Those who said that they had only impulses were the highest with approximately 53%, and those who did not have any abnormality from their point of view and that of others were about 12%.

I will explain next in more detail about each item and the relation between the period of the impediment of consciousness and the ages.

表4 検査結果の概観

1 器質的障害あるもの	2 知的障害	167名	24.9%	28.2%
	3 性格変化	81	12.1	
	4 神経学的異常（失行・失語を含む）	52	7.7	
	5 自律神経障害	28	4.2	
6 器質的障害認めないもの	7 神経症	41	6.1	71.8
	8 衝動のみ	358	53.4	
	9 異常なし	83	12.4	

Chart 4. Conspectus of the result of the examination

1. Those with the organic impediments.
2. Intellectual impediments
3. Character affected
4. Neurological abnormality (includes abatement and loss of one's consciousness)
5. Self-nervous impediments
6. Those without the organic impediments
7. Nervous disorder
8. Impulses only
9. No abnormality

3. Organic impediments

1) Intellectual impediments: I divided this impediment into three groups. The high degree is those whose idiocy is such that they hardly have any labor ability. Idiocy is not so high but such that sometimes causes to forget the date or miscalculate and it's clear that there are some problems at work or at regular life is classified as middle degree. I classified those that found the new impediments of memory after the examination and may cause some problems at work depending on the type of work, when though they appear completely normal as the low degree. In determining these

degrees, I didn't consider merely one's labor ability but how much his intellectual ability went down after encountering the accident by comparing it with his schooling and background before the accident. Since the examination took a short time, there might have been a few mistakes or some which are classified in the low degree may have included the idiocy by nature. However, in the after affect of carbon monoxide poisoning, there are many who indicate this type of intellectual impediment. There were 25% of these which were classified in intellectual impediment.

2) Affected character: The general characterisitcs of the change in character is becoming less agressive, more passive, more flat, more childish, more frivolous and so on. Those who are not able to live the family life as well as the social life without any help are classified as the high degree. Those who are not such, but definitely have problems in their regular life is so clear in the first interview are classified as the middle degree. Those who look normal to the third person, if their relatives and close friends indicate the change in their characters and the medically speaking, it indicates some what, then they are classified in the low degree. Those who are classified in the affected character are 12% of the whole.

3) Neurological abnormality: For convenience sake I included in this item the following: the pyramidal path impediment whose main symptom is the excitement of the reflection of the deep part, the pyramidal outer path impediment whose main symptom is the muscle constriction of the legs and arms, those who show the symptom of the abatement of loss of consciousness (21 cases) or epileptic con-

vulsion fit (5 cases). Those with the symptom of the abatement or loss of the consciousness showed above the middle degree of the intellectual impediment. It seemed to me that there might have been more in case of more detail examination. Those who had such neurological abnormality accounted for 8% of the whole.

4) Self-nervous impediment: I included in this category mainly those who had cold and sticky sweat in their hands. But also did I include those with a uniformed one side headache type fit. However, with the cross case study of those with extreme amount of cold sweat in the hands, I found some who did not show the symptoms constantly, and I thought that we had to give more serious consideration in order to determine them to have been caused by the carbon monoxide poisoning. Therefore, I classified, them separate from the neurological abnormality, but most of them had other symptoms of any organic impediments that I have been talking about.

Those who showed the symptoms of the organic impediments mentioned above were 189 (approximately 28%). When we gather the total of each type of the impediments and see how it is degree wise, we find approximately 3% of the high degree, 8% of the middle degree, and 17% of the low degree (Chart 5).

The degrees of all the impediments were determined according to mainly the degree of the intellectual impediments and affected characters and with reference to the neurological abnormality. For convenience's sake, I will contrast the degrees with the degree chart of the injury compensation by the workmen's compensation insurance: The high degree corresponds to the third degree or more, the middle degree corresponds to 4 to 7 degree, the low degree corresponds to 9 to 12 degree.

表5 器質的障害の程度別内訳

1 被検者数	2 軽度	中等度	高度	3 計
671	118	51	20	189
	(17.6)	(7.6)	(3.0)	(28.2)

4 ( ) 内は%

Chart 5. Degree wise classification of the organic impediments

1. # of examinees
2. Low Degree, Middle Degree, High Degree
3. Total
4. Inside ( ) is %

5) The relation with the impediment consciousness: As we can see in the Chart 6, it is obvious that the longer the time of the impediment of consciousness is, the higher is the rate of the organic impediments. Those who had the impediments of consciousness for more than 20 hours, retain the impediments by almost 100%, and those for more than 30 hours, retain either middle or high degree of their impediment.

表6 器質的障害の発生と意識障害時間の関係

3 意識障害時間 ＼ 1 器質的障害 ／ 2 被検者	4 軽度	5 中等度	6 高度	7 計
0	301	0	0	0	0
0 ～ 10	224	60 (26.8)	8 (3.6)	1 (0.4)	69 (30.8)
10 ～ 20	105	52 (49.5)	27 (25.7)	1 (1.0)	80 (76.2)
20 ～ 30	22	5 (22.7)	11 (50.0)	5 (22.7)	21 (95.5)
8 30 以上	17	0	4 (23.5)	13 (76.5)	17 (100.0)
9 不 明	2	1	1	0	2

10 ( ) 内は%

Chart 6. The relation of the occurrence of the organic impediments and the time of the impediment of consciousness.

1. Organic impediments
2. # of examinees

3. Time of the impediment of consciousness
4. Low Degree
5. Middle degree
6. High Degree
7. Total
8. 30 or more
9. Unknown
10. Inside ( ) is %

6) The relation with ages: Concerning the relation between the occurrence of the impediments and ages, as it is shown in Chart 7, it is hard to admit the effect of ages in the low and middle degree. But, in the high degree impediment, there are more young people (7% under 25 years of age) and less older people (approximately 2% in the 46 to 55 age group). This an unexpected result.

表7 器質的障害の発生と年令との関係

3 年令 \ 1 器質的障害 / 2 被検者		4 軽度	5 中等度	6 高度	7 計
8 25 以下	43	7 (16.3)	2 (4.7)	3 (7.0)	12 (27.9)
26 ～ 35	201	41 (20.4)	18 (9.0)	6 (3.0)	65 (32.3)
36 ～ 45	262	43 (16.4)	20 (7.6)	8 (3.1)	71 (27.1)
46 ～ 55	163	27 (16.4)	11 (6.7)	3 (1.8)	41 (24.8)

9 ( ) 内は%

Chart 7. The relation of the occurrence of the organic impediments and ages.

1. Organic impediments
2. # of examinees
3. Age
4. Low degree
5. Middle degree
6. High degree
7. Total
8. Under 25
9. Inside ( ) is %

4) Nervous disorder: Those I included in the nervous disorder are hysteria, pseudo-idiocy, mental and nervous disorder of the strong insecurity and those which require some kind of mental treatment. Those with the symptoms of nervous disorder based on organic impediments (8 cases) were excluded from this item. Those who showed the mind tendency suspected to have resulted from lack of medical instruction or explanation were included in the item of impulse only. Those who showed the clear nervous disorder were about 6% of the whole.

1) The relation with the impediment of consciousness. As it is shown in Chart 8, it seems that the nervous disorder occurred more to those who did not suffer the impediment of consciousness.

表8 神経症と意識障害時間

意識障害(時)	被検者(名)	神経症者(名)
0	301	24 (8.0)
0～10	224	14 (6.3)
10～20	105	3 (2.5)
20～30	22	0
30以上	17	0
不明	2	0

( )内は%

Chart 8. Nervous disorder and duration of impediment of consciousness.

1. Impediment of consciousness (hours)
2. # of examinees
3. # of those who suffered mental disorder.
4. 30 or more
5. Unknown
6. Inside ( ) is %

2) The relation with ages: As it is shown in Chart 9, there is a tendency of more occurrence among young people than older people. We could see that there are few in the group of 46 to 55, who are considered to reflect the insecurity of the life hence,

facing retirement (55 years old). Is this due to the fact that there are many who have retired after 5 years from the time of the occurrence of the accident?

表9 神経症と年令

1 年令(才)	2 被検者(名)	3 神経症者(名)
4 25以下	43	1 (2.3)
26 ~ 35	201	8 (4.0)
36 ~ 45	262	21 (8.0)
46 ~ 55	165	11 (6.7)

5 ( ) 内は%

Chart 9. Nervous disorder and ages

1. Age (years old)
2. # of examinees
3. # of those who suffered nervous disorder
4. 25 or under
5. Inside ( ) is %

5) Impulses only

I included in this item of impulses only the following: those who could recognize the symptoms by themselves but they are not apparant to others, those with the symptoms which might not be due to the carbon monoxide poisoning (for example, high blood pressure), and those who have simple impulses of their minds. As the result of the examination, these cases in this catagory accounted for 53.4%, which was the highest of all.

1) the Types of impulses: There are various types of impulses (Chart 10): headache and heavy head (approximately 43%) forgetfulness (approximately 26%), fatigue (approximately 14%), arthralgia (approximately 13%), sleeplessness (approximately 13%), diziness (approximately 10%). There were very many who had them. Others are tinnitus aurium

(9%), waste ache (7%), impediment of intestines (6%), muscle constriction (mainly lower bowel muscle (5%), extreme perspiration (3%), impotent (2%).

2) The relation with impediment of consciousness. As it is shown in Chart 10 also, number of forgetfulness increases in proportion to the duration of the impediment of consciousness. The reason why there are fewer among those with more than 30 hours of duration of the impediment of consciousness is because that most of them were classified in the organic impediments and they do not have mere impulses. Contrary to this, there are more of those with the impulses of headache, fatigue, arthralgia, sleeplessness, dizziness among those with short duration of impediment of consciousness or no duration at all.

3) The relation with ages. In the impulses if we take forgetfulness, which is suspected to have some relation with carbon monoxide poisoning, there is not any significant relation with ages, but if we take the total of all impulses, the number increases as the age becomes older (Chart 11). Especially the cases of headache and heavy head, dizziness, tinnitus aurium increase with high ages.

4) Concerning high blood pressure. In the impulses there are many which are suspected to be due to the high blood pressure such as headache and heavy head, dizziness, and tinnitus aurium. Also, from the result of the blood pressure measurement at the time of the examination, there were quite a few who had high blood pressure (the highest 150 mm Hg or the lowest 90 mm Hg or more). So I made the investigation based on the records of the health diagnosis by the Coal Mines Company between the blood pressure measurements

of the carbon monoxide poisoned before the accident and the counterpart group, which did not suffer the accident, taking measurements before and after 5 years. The result of the investigation is shown in Chart 12. I could not find any significant difference between the group of the carbon monoxide poisoned and its counterpart group.

表10 自覚症状と意識障害時間

1 意識障害(時)	2 被検者(名)	3 頭痛・頭重	4 物忘れ	5 疲労性	6 関節痛	7 不眠	8 めまい
なし	301	142 (47.2)	24 (8.0)	45 (15.0)	46 (15.3)	38 (12.6)	40 (13.3)
10以下	224	98 (43.8)	63 (28.1)	33 (14.7)	28 (12.5)	34 (15.2)	19 (8.5)
10～20	105	44 (41.9)	66 (62.9)	11 (10.5)	10 (9.5)	9 (8.6)	9 (8.6)
20～30	22	5 (22.7)	14 (63.6)	2 (9.1)	1 (4.5)	3 (13.6)	0
30以上	17	1 (5.9)	4 (23.5)	0	0	0	0
不明	2	0	2	0	0	0	0
計	671	290 (43.2)	173 (25.8)	91 (13.6)	85 (12.7)	84 (12.5)	68 (10.1)

9 ( ) 内は%

Chart 10. Self-recognized symptoms and duration of the impediment of consciousness.

1. Duration (hours)
2. # of examinees
3. Headache (heavy head)
4. Forgetfulness
5. Fatigue
6. Arthralgia
7. Sleeplessness
8. Dizziness
9. Inside ( ) %

表11 自覚症状と年令

1 年令	2 被検者(A)	3 頭痛	4 物忘れ	5 疲労性	6 関節痛	7 不眠	8 めまい	9 耳鳴り	10 その他	11 計(B)	B/A
25以下	43	9 (20.9)	12 (27.9)	8 (18.6)	4 (9.3)	6 (14.0)	3 (7.0)	4 (9.3)	22 (51.2)	68	1.6
26～35	201	78 (38.8)	59 (29.4)	37 (18.4)	18 (9.0)	14 (7.0)	16 (8.0)	10 (5.0)	122 (60.7)	354	1.8
36～45	262	111 (42.4)	67 (25.6)	36 (13.7)	37 (14.1)	40 (15.3)	29 (11.1)	25 (9.5)	162 (61.8)	507	1.9
46～55	165	92 (55.8)	35 (21.2)	10 (6.1)	26 (15.8)	24 (14.5)	21 (12.7)	24 (14.5)	110 (66.7)	342	2.1

12) 内は%

Chart 11. Self-recognized symptoms and ages

1. Ages
2. Examinees (A)
3. Headache
4. Forgetfulness
5. Fatigue
6. Arthralgia
7. Sleeplessness
8. Dizziness
9. Tinnitus Aurium
10. Others
11. Total (B)
12. Inside ( ) is %

表12 高血圧をしめしたもの ——対照群との比較——

	被検者	検診時に高血圧をしめしたもの	被災前に高血圧をしめしたもの	平均年令
CO群	671	143 (21.3%)	48/115*(41.8%)	41.7
対照群**	300	65 (21.7%)	28 (43.1%)	40.9

* 検診時に高血圧をしめしたもののうち，被災前（5年前）の血圧測定の記録のみつかったものは115名で，そのうち48名が すでに高血圧をしめしていた
** 対照群は42～43年と37～38年の測定記録によった

Chart 12. Those who showed high blood pressure

1. # of examinees
2. # of those who showed high blood pressure at the time of examination
3. # of those who showed high blood pressure before suffering the accident
4. Average age
5. CO group
6. Counter part group *

* Of all those who showed high blood pressure at the time of the examination, 115 had the record of the blood pressure measurement before suffering the accident (5 years ago).
** The counterpart group's records are according to those that were measured in 1967-1968 and 1962-1963.

6) The place of suffering the accident and organic impediment.

The shaft location of Mitsui Coal Mine is very complicated and it's very difficult to break it down. The material of the Coal Mine Company divides it into 26 sections, but here I broke it down to four major parts with the death ratio at the place as basis. The

Part I had equal to or more than 50% of death rate; Part II 25 to 50%; Part III, 25 to less; Part IV, no deaths. Chart 13 explains how much the organic impediments occurred in the four parts. As it is shown in the chart, the occurrence rate of the organic impediments is higher in Part II (53.7%) where the death rate is lower and here it is expected to have had less CO density than in Part I (30.5%), where the death rate is higher and hence CO density is expected to have been greater. This is probably because Part I was closer to the mouth of the shaft and hence the rescue came earlier, whereas Part II was far from the mouth and the rescue was delayed and the people there were exposed to carbon monoxide longer. Part III had relatively less carbon monoxide compared to Part I and Part II. In Part IV, there was a possibility of carbon monoxide coming in by the explosion, but since it received the air from the different channel from that of Parts I, II, III; the air was refreshed quickly there.

表13 被災場所による器質的障害発生のちがい

被災場所 1	被検者 2	器質的障害をあらわしたもの 3
I	46	14 (30.4)
II	254	137 (53.9)
III	232	36 (15.5)
IV	139	2 (1.4)
計	671	189 (28.2)

4 ( ) 内は%. 説明本文

Chart 13. Difference in organic impediments occurrences according to the places of encountering the accident.

1. Place of encountering the accident
2. # of examinees
3. # of those with organic impediment
4. Inside ( ) is %.

7) The condition of returning to work

As it is shown in Chart 14, the condition of returning to work of those who suffered the accident is approximately 70% at the time of the examination. If I exclude the people who had retired from the examinees, it would become approximately 77%. Such ratios of those returning to work is very low compared to that of the carbon monoxide poisoned in other coal mine accidents. For example, in the gas explosion of Yamano Coal Mine in 1964, about 100% of the carbon monoxide poisoned returned to work by July of 1966 excluding those who had retired.

表14 職場復帰状況

1	2 坑内就労	3 坑外就労	4 計
5 新労 (376名)	242 (64.4)	38 (10.1)	280 (74.5)
6 三労 (232〃)	11 (4.7)	126 (54.3)	137 (59.1)
7 職組 (34〃)	22 (64.7)	3 (8.8)	25 (73.5)
8 総労 (29〃)	23 (79.3)	0	23 (79.3)
計 (671〃)	298 (44.4)	167 (24.9)	465 (69.3)*

9・退職者 (67名) を除くと約77%となる 10) 内は%

Chart 14. The condition of those returning to work.

1. Labor Unions that the examinees belonged to
2. Work in the shaft
3. Work outside of the shaft
4. Total
5. Shinro
6. Sanro
7. Shokuso
8. Sofu
9. * Excluding those who had retured (67), it would become about 77%.
10. Inside ( ) is %.

Also, the condition of those returning to work is lower for those who belong to the special labor unions. As to returning to the shaft, notice there is conspicuous difference.

Consideration

There have been numerous reports and general explanations about the residual symptoms of the carbon monoxide poisoned, so, I will take those items that impressed me particularly from the examination that I have undertaken.

1. Comparison with other carbon monoxide poisoning occurred in a group.

In the Miike Coal Mine explosion accident, approximately 28% of the whole are deduced to retain organic impediments. Comparing with other carbon monoxide poisoning occurred in a group, this percentage is quite high. The gas explosion accident in Yamano Coal Mine in June of 1965 caused 237 deaths (43% of those who were in the shaft) on the spot. Judging from the death rate,this is a larger accident than that in Miike Coal Mine, but out of all the survivors only seven (about 2% of the survivors) of them retained the residual symptoms[13]. In the accident a couple fires in the shaft occurred in the Mikawa Coal Mine in September of 1967, there were seven who died of carbon monoxide poisoning and some 300 people suffered the accident, but they did not retain any residual symptoms which were seen in the Miike Coal Mine accident[9].

In an accident case not in a coal mine, but in the accident occurred to a group in a factory, there were six dead and some 250 were carbon monoxide poisoned. But there was only one (0.4%) who showed still the same symptom fifty days after the accident. Though it did not occur in a group, Shillito[12] reports about the carbon monoxide poisoned case which occurred in a place for ten years. According to his report, one third died, but of the survivors, only

39 people (0.2%) were put in the mental hospital because of their serious residual symptoms.

Katsuki and others reported that as of two years after the accident, the Miike Accident retained many more people with serious residual symptoms than other large group accidents, comparing it with the accidents occurred in a group in the Yamano Coal Mine, Yubari Coal Mine, and Iojima Coal Mine. And at the point of three and one half years after the accident, when most of the symptoms were supposedly fixed, Tachizu[14] and others made the investigation with 562 sufferers of the accident. According to the result of their investigation, the high rate such as 68.5% (calculated from Chart 4 of the report by Tachiki and others) admitted the organic impediments even though samples were relatively mild cases excluding those who were in the hospital. Of course it is deduced that one third of them had the symptoms by nature and if we exclude them, we have approximately 36%. Without consideration of which of the results of the investigations, mine or Tachizu and others, is more accurate, either of them shows the fact that the accident of Miike Coal Mine has left many residual symptoms compared with other carbon monoxide poisoning occurred in a group.

As the reasons why the carbon monoxide poisoning in the Miike Coal Mine accident caused exceptionally great number of the people with residual symptoms, the following reasons can be considered: The density of carbon monoxide was enough to cause the residual symptoms; it took long time to rescue everyone; these are two main reasons, but as other reasons the following are considered also: the type of explosion, condition of the air stream, etc. I will present more detail reports separately on this subject.

2. Intermittent type

According to the studies that Fujii and others made about the report cases on the residual symptoms of the carbon monoxide poisoning in Japan, about a half of them are intermittent type. Therefore, at the time of the accident, it was feared that there would be lots of intermittent type cases, but contrary to the expectation not many of them occurred. According to my investigation, those with "freie Interval"[11] accounted for approximately 1%, those with impediment of their consciousness accounted for approximately 2%. Azumaya[16] finds five cases of intermittent type out of 93 examinees (approximately 5%). But in them he includes two special cases with main symptoms of extremely weak affection, which generally are not included. According to the report on 51 relatively major cases published by the Miike Medical Committee[7] there were four cases (8%) of intermittent type. (Those cases which were not clear were investigated later.) However, it is found that there were seven cases (14% of those who did not have "freie Interval," but had the symptoms becoming worse in a few days or few weeks period). Considering these symptom cases, I tend to think that the intermittent type and non-intermittent type are not to be distinguished very clearly. I remember Pohlisch[10] divided the after effects of carbon monoxide poisoning into unkomplizierte Weiterverlauf and komplizierte Weiterverlauf and placed Sibelius' intermittent type in the latter.

3. Impediment of the intellectual organ

In the carbon monoxide poisoning of Miike accident, the impediment of the intellectual organ accounted for the most and it was

the core of the residual symptoms. There are various degrees from idiocy, the highest, to memory impediment, the lowest, in intellectual impediments. The characteristics of the memory impediments of minor cases were such that when the system of the memory was analyzed in engraving, maintaining, and recollecting the impediment of maintaining ability seemed to be the strongest. For example, one may really do well in the engraving test of reverse reciting numbers, but he hardly recollects the $300 million Robber Incident (the sensation incident of latter of part of 1968) or Mexico Olympics (October, 1968) etc., and after receiving some hints and our judging from one's schooling he is well able to pass the written exam to get the motor cycle license, yet, he fails in every test after a few attempts. But they who indicated this type of memory impediment gave the quick right answers to the mental arithmetic test and the attitude and the ways to answer are just normal, therefore, I could not help judging their memory impediments were due to carbon monoxide poisoning.

Most of those who were considered to have minor organic impediments indicate the impediments of new memory like these. If I say it generally, those who indicate neurological abnormality including abatements and loss of one's consciousness and affected characters combine themselves for the first time as their intellectual impediments indicate higher than middle degree.

4. The relation of organic impediments and ages

It is easy to understand that the organic impediments and the duration of the impediments of consciousness are in interrelated. But their relation with ages yields the result unexpected by common knowledge. As I indicated in Chart 7, in those with suspected organic impediments, it was hard to recognize a significant relation between low and middle degree impediments and ages. However, there were more young people who indicate high degree impediments and fewer old people. This, as indicated in Chart 2, is due to the relation that the older people have high rate of death. Upon receiving the brain impediments, the older people die, while younger people survive but with the high degree of residual symptoms.

From the result of the experiment research of residual symptoms of carbon monoxide poisoning, it became clear that the important factor for an animal to survive under carbon monoxide poisoning is the strength of its heart and lung system. An animal with the stronger heart and lung system survives the longer under carbon monoxide poisoning, and therefore, he retains the serious residual symptom after the poisoning. But an animal with weak heart and lung system easily dies under carbon monoxide poisoning and if he barely escapes from death, he usually has no or low degree residual symptoms. In the case of human beings, also, it is expected for older men to have the weaker heart and lung system than the younger, therefore, they have the higher death rate yet if they survive, they have much less serious cases of residual symptoms compared with the younger. In the case of the accident of Miike Coal Mine also, the two most serious cases (still under the hospital care of

the First Internal Treatment of Kumamoto University Hospital), who are still in bed and cannot speak a word, can hardly move by themselves, were 21 years old and 23 years old at the time of the accident.

5. About the nervous disorder and other problems

Concerning the neurotic tendency and mental symptom items of the sufferers of the Miike Coal Mine accident, Yasukauchi and Tomonari have already pointed out that the sufferers received more economical advantages than those who received workman's compensation insurance, therefore, there were good possibilities that by having the illness there were also economic advantages. Moreover, in the background of becoming this way, there is a peculiar industrial and labor relation of Mitsui and Miike Coal Mine Company and the difference of understanding of one's suffering of the accident by each labor union yields the difference of constitution of nervous disorder symptoms and the rate of returning to the job.

In this investigation, of those which were hard to determine organic impediments, I distinguished the ones which clearly showed the nervous disorder symptoms and the others which had impulses which were hard to believe as being carbon monoxide symptoms (within these, there were some which showed mental tendency somewhat, but they did not receive the professional medical cares).

Those who showed clear nervous disorder were 6%. If we look at them by labor unions to which they belonged; those that belonged to Shinro, Shokuso and Sofu were some 3%, whereas those that belonged to Sanro were 12%, which is very high. On the other hand, those without any impulses or any symptoms perceived by other people were

12 to 20% among those that belonged to Shinro, Shokuso, and Sofu, whereas there were none among those that belonged to Sanro. But all claimed to have some physical trouble. But there were overwhelming numbers of people who classified themselves in "impulses only" among not only those who belonged to Sanro, but also those who belonged to other labor unions. There were many who were thinking that these self-recognized symptoms had something to do with carbon monoxide poisoning, but I felt the lack of medical instructions about carbon monoxide poisoning among them. Also, there were peculiar speculations to call the sufferers "gas patients" around them, which caused the atmosphere of growing their impulses.

The fact that the difference in acceptance of the sufferers by each labor union is conspicuously indicated in returning to the job particularly in the difference of returning rate to the shaft work (chart 14). Those who belong to Shinro, Shokuso and Sofu account for one digit lower. When we consider the fact that the death rate of each labor union is about the same (31% to 34% for all the unions), it is difficult to think that more sufferers belonging to Sanro retain the residual symptoms that disable them to return to the shaft work.

The difference seen among each labor union such as this was already noted from the early period of the medical cure of the accident. Of 945 survivors, approximately 89% (839) were recognized to be of the carbon monoxide poisoned, but if we break it down to each labor union, while 69 to 85% of the survivors of Shinro, Shokuso and Sofu were recognized to be the carbon monoxide poisoned, 100% of the survivors of Sanro were recognized to be so.

As we have seen so far, it is obvious that the occurrence of nervous disorder, existence or non-existence of impulses, and difference of one's belonging to labor unions as to returning to work are not due to only medical condition, but also the industrial labor relation of Mitsui Miike Coal Mine, which has particularly become acute, and ideological difference of the leaders of each labor union on their decisions for the accident.

However, this fact is not limited to only sufferers of the Miike Accident from other patients of workers' accidents. Rather, the various contradictions which exist in an individual sufferer of other workers' accidents became a large scale of a group and organized in the Miike Coal Mine Accident. Therefore, there have been raised various problems caused by the essence of the accident.

Concerning this subject, I am planning to discuss more in detail in another paper.

Summaries

1. I undertook the investigation with the purpose of understanding the actual condition of the carbon monoxide poisoned due to the explosion in the Miike Coal Mine five years after the accident. The examination coverage was approximately 81% (671).
2. Those with organic impediments were measured to be approximately 28%. Of them, those with intellectual impediments were approximately 25%, with affected characteristics approximately 12%, with neurological abnormality 8%, with self-nervous impediments approximately 4%, and many of these impediments appeared combined together.

The occurrence of the residual symptoms of carbon monoxide poisoning due to the explosion of Miike Coal Mine has higher rate

than other occurrences in a group, We cannot discuss the group occurrences of carbon monoxide poisoning with the same base.

3. Those who had organic impediments had definite correlation with the duration of the impediments of consciousness at the time of the accident. With the ages, it does not have such a definite correlation, but it is noted that there were more young people when it comes to the high degree impediments.

4. Looking at the occurrence rate of the organic impediments by various location of one's encountering the accident, it was higher in the place where death rate is lower with 25 to 50% and carbon monoxide density was also lower than in the place where death is high with 50% or more and carbon monoxide density was also higher. This difference indicates that the occurrence of residual symptoms of carbon monoxide poisoning is due to a certain density of carbon monoxide and the duration of exposure to it.

5. The intermittent type was seen approximately in one percent of the whole. Among rather serious cases, there were some incomplete intermittent type, and I pointed out the difficulty of distinguishing clearly between intermittent type and non-intermittent type.

6. Those with definite nervous disorder accounted for approximately 6%, those with impulses of some physical and mental problems accounted for approximately 53%, and those without any abnormality accounted for approximately 12%.

7. I indicated that there was a conspicuous difference by each labor union to which a sufferer belonged in returning to his job. To solve this problem, the social science approach with the medical factors is necessary.

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三池災害による急性一酸化炭素中毒者の5年後の実態

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A. Yukitake : Clinical Investigation on Acute Carbon Monoxide Poisoning due to Explosion in Miike Coal Mine Five Years after the Accident

（1969年12月1日受理）

はじめに

昭和38年11月9日，三井三池鉱業所三川鉱における炭じん爆発は，一挙に458名の死者をだした戦後最大の産業災害であったが，同時に数百名にのぼる急性一酸化炭素中毒（CO中毒）者を発生させるという医学的にも稀有な災害であった．三池災害によるCO中毒者にかんしてはすでに多くの報告[4~7,10,16,17,19]があるが，それらは比較的重症者を対象としたものである．軽症者についての報告[15]は少ないので，三池災害の医学的全貌の把握には不十分である．

また，三池災害によるCO中毒者は業務上の障害として労災保険による治療をうけたが，治癒ないし症状固定の認定をめぐって通常の患者－医師関係がこわれ，その解決は主治医の手をはなれておこなわれるという異例の事態にたちいたり，紛糾をつづけてきた．

このように，三池災害はわれわれ医師に興味ある医学的経験をさせたというばかりでなく，産業災害やその医療のあり方についてあらためて考えなければならない多くの問題を提起したのである．

私は三池災害後満5年を経過した時点で，全CO中毒者の実態を把握するために検診を計画した．これまでにも大牟田近傍の各大学その他の専門医による一斉検診が行なわれているが，多数の医師による検診であったために一定の規準によって全貌を把握できる資料とはならなかった．今回の検診は私一人がおこない被検者数は671名（約81%）となり，CO中毒者全体の実態をほぼ反映していると思われるので，たんに医学的関心にとどまらず前述のような社会的問題を考えるための基礎資料としてここに結果を報告する．

調査方法

調査対象：CO中毒と認定された839名のうちすでに死亡した10名（44年4月末現在）を除く829名を対象としたが，転出その他の事情により検診できたものは671名（80.9%）であった．

調査期間：43年11月より44年4月末までの期間に検診した．

検診方法：あらかじめ対象者について個人票を作成した．個人票には三井三池鉱業所病院作成の資料[9]にもとづいて，被災者の年令，被災場所，その場所における死亡率（災害当時のCO濃度は測定されていないため，死亡率はそれを推定する資料の1つである），意識障害の時間，所属労組などを記載しておいた．次いで個々の患者と面接し，被災場所と意識障害の有無を確かめたのち，自覚症状をきき簡単な神経学的検査と血圧測定をおこなった．それまでの応答や態度から精神面の障害が疑われるものや意識障害のあったものについては，簡単な精神科的問診による検査をおこなった．入院中のものや通院中のものについてはそれぞれの診療録をも参照した．若干の例とくに間歇型が疑われる例については急性期の診療録（鉱業所病院，荒尾市民病院）を参照した．検診に要した時間は個々の例でことなるが，数分ないし30分ぐらいの間にその主要病像をとらえることにつとめた．

意識障害の時間は，なし，10時間以内，10～20時間，20～30時間，30時間以上に区分した．年令は，被災当時の年令を25才以下，26～35才，36～45才，46～55才に区分した．最若年者は18才，最高令者は57才で，56～57才は5名あったが，これは便宜上46～55才の群にいれた．

結果

1. 事故当時の状況

炭じん爆発当時の入坑者，死亡者，生存者およびCO中毒と認定されたものは表1にしめすとおりである．死亡者は458名で入坑者の約32%にあたるが，その大部分

表1 事故当時の被災状況

1 入坑者	1403名
2 死亡者	458
3 生存者	945
4 急性CO中毒症と認定された者	839

はCO中毒によるものであり，爆発自体の火傷や外傷によるものは20名といわれている[7]．生存者のうち839名（約90%）がCO中毒と認定されたが，そのうち意識障害のあったものは約52%で，残りのものは意識障害を経験していない．ここでいう意識障害は，事故時に意識不明となり一定時間の健忘をもつものをいう．

各年令別による死亡率をみたのが表2である．25才以下のものは約26%の死亡率であるが，年令の増加とともに高率となり46～55才では37%，56～57才の5名では2名（40%）が死亡している．死亡率は高令者において明らかに高率となっている．

表2 年令別死亡率

1 年令（才）	2 入坑者（名）	3 死亡者（名）	4 死亡率（%）
25以下	104	27	25.9
26～35	397	118	29.7
36～45	520	172	33.1
46～55	373	139	37.3
56～57	5	2	40.0
6 不明	4	0	0
7 計	1,403	458	32.6

CO中毒にかんしては間歇型が1つの関心事である．今回のCO中毒者で完全間歇型をあらわしたものは6例（約1%）であり，意識障害のあったものについては約2%の発生率となる．年令，間歇期は表3にしめすように高令者に多い傾向はみられず，間歇期は3～43日にわたっていた．

表3 間歇型症例

1 症例	2 年令（才）	3 間歇期（日）
Tom.	27	12
Mar.	29	3
Mat.	36	7
N.	41	36
Tag.	54	31
H.	53	43
4 平均	40	22

2. 検診結果の概観

検診の結果をまとめたものが表4である．器質的障害が推測されたものは約28%であるが，そのなかで知的障害がもっとも多く約25%にみとめられた．性格変化は約12%，神経学的異常は約8%，自律神経障害は約4%であった．これらの障害のなかの1つだけをあらわしているものは約半数であるが，その大部分（器質的障害者の約40%）は知的障害であった．残りのものは2つ以上を合併しているのであるが，知的障害と性格変化をあらわすものが多く（約20%），ついで知的障害，性格変化および神経学的異常をあらわすもの（約13%）が多かった．つぎに，神経症としたものは全体の約6%，訴えのみとしたものは約53%でもっとも多く，自覚的にも他覚的にも異常をみとめなかったものは約12%であった．

表4 検診結果の概観

1 器質的障害あるもの	2 知的障害	167名	24.9%	28.2%
	3 性格変化	81	12.1	
	4 神経学的異常（失行・失認を含む）	52	7.7	
	5 自律神経障害	28	4.2	
6 認めないもの	7 神経症	41	6.1	71.8
	8 訴えのみ	358	53.4	
	9 異常なし	83	12.4	

各項目の内容と意識障害時間および年令との関係について次に述べる．

3. 器質的障害

1) 知的障害：この障害を大まかに高度，中等度，軽度の3段階に分けた．痴呆のために労働能力をほとんど喪失していると思われるものを高度，高度の痴呆ではないが記憶障害が強く日付の失見当や計算障害をしめし，労働や日常生活にも支障をきたすことがはっきりうかがえるものを中等度，一見したところ異常はないようであるが問診の結果新しい記憶の障害があり，労働の内容の如何によっては支障をきたすこともあると思われるものを軽度とした．たんに一般的労働能力を問題にすることなく，被災前の知的能力がどの程度に落ちたかを，学歴その他を参考にして推定し障害の程度を考えた．短時間の診察であったために，軽度の障害とみなしたものの中には生来性のものも多少はいりこんでいるであろうし，また見落とされたものもあろうかと思われる．しかしCO中毒後遺症にはこのような知的障害をあらわすものがもっとも多く，全体の約25%にみられた．

2) 性格変化：性格変化の一般的特徴は，積極性低下，

受動的，平坦化，幼児化，浮薄化といったものであるが，社会生活はもちろん家庭生活をも介助なしにはおこないえないものを高度，それほどではないが，日常生活でも明らかに支障をきたすことが，1回の面接でうかがえるようなものを中等度，第3者には一見したところ異常はないようにみえても，近親者や親友などから性格変化を指摘されており，医学的にもそのことが十分考えられるようなものを軽度とした．性格変化は全体の約12%にみられた．

3) 神経学的異常：深部反射の亢進を主徴とする錐体路障害や，四肢の筋強剛を主徴とする錐体外路障害のほかに，失行・失認をしめすもの（21例）や，てんかん性けいれん発作をしめすもの（5例）も，便宜上この項目にいれた．失行・失認をあらわすものは，知的障害が中等度以上のものにあらわれていたが，仔細に検索すればもっと多いのではないかと思われた．このような神経学的異常は全体の約8%にみられた．

4) 自律神経障害：冷たい油状の手掌発汗のあるものを主としてとりあげ，定型的な片頭痛様発作などもふくめた．しかし手掌発汗の過多なものについて縦断的にみた例では，この症状はかならずしも恒常的にみられないものもあり，これをCO中毒による後障害とみなすには慎重でなければならないと思われたので，前記の神経学的異常とは別にまとめたが，その大半はこれまで述べた器質的障害のいずれかを合併していた．

以上のような器質的障害をあらわしたものは189名（約28%）であったが，各種の障害を綜合してその程度をみると，高度は約3%，中等度は約8%，軽度は約17%である（表5）．綜合された障害の程度は，主として知的障害と性格変化の程度のより強いものをとり，神経学的異常を参照して決めたものである．便宜上，労災保険による障害補償の等級表に対応させてみると，高度としたものは3級以上，中等度は4～7級，軽度は9～12級に相当するものと思われる．

表5 器質的障害の程度別内訳

被検者数	軽度	中等度	高度	計
671	118	51	20	189
	(17.6)	(7.6)	(3.0)	(28.2)

（ ）内は%

5) 意識障害との関係：表6にしめすように，当然のことながら意識障害の時間が長いものほど高率に器質的障害がみられる．20時間以上の意識障害のあったものはほぼ100%に障害を残しており，30時間以上になるとすべて中等度ないし高度の障害を残している．

表6 器質的障害の発生と意識障害時間の関係

意識障害時間	被検者	軽度	中等度	高度	計
0	301	0	0	0	0
0 ～ 10	224	60 (26.8)	8 (3.6)	1 (0.4)	69 (30.8)
10 ～ 20	105	52 (49.5)	27 (25.7)	1 (1.0)	80 (76.2)
20 ～ 30	22	5 (22.7)	11 (50.0)	5 (22.7)	21 (95.5)
30 以上	17	0	4 (23.5)	13 (76.5)	17 (100.0)
不　明	2	1	1	0	2

（ ）内は%

6) 年令との関係：年令と障害の発生については，表7にしめすように，軽度ないし中等度の障害では年令による差異は認めがたいが，高度の障害を残しているものは若年者に多く（25才以下で7%），高令者になると少なくなっていた（46～55才で約2%）．これは予想に反した結果であった．

表7 器質的障害の発生と年令との関係

年令	被検者	軽度	中等度	高度	計
25 以下	43	7 (16.3)	2 (4.7)	3 (7.0)	12 (27.9)
26 ～ 35	201	41 (20.4)	18 (9.0)	6 (3.0)	65 (32.3)
36 ～ 45	262	43 (16.4)	20 (7.6)	8 (3.1)	71 (27.1)
46 ～ 55	165	27 (16.4)	11 (6.7)	3 (1.8)	41 (24.8)

（ ）内は%

以上のような器質的障害は意識障害のなかったものにも認められたとする報告もあるが[10]，私が検診した範囲では器質的障害を残すものはすべて意識障害を経たものであった．

4. 神経症

神経症としてとりあげたものはヒステリー，偽痴呆，強度の不安神経症や心気症で，なんらかの精神的処置を要すると思われるものに限った．器質的障害を基盤にして加重された神経症症状をもつもの（8例）は除外し

た．医学的啓蒙や説明の不足などからくると思われた心気傾向をしめすものは，訴えのみの項にいれた．はっきりした神経症は全体の約6％にみられた．

1） 意識障害との関係：表8にしめすように，意識障害のなかったものにむしろ多く発生しているようにみえる．

表8 神経症と意識障害時間

1意識障害（時）	2被検者（名）	3神経症者（名）
0	301	24 (8.0)
0 ～ 10	224	14 (6.3)
10 ～ 20	105	3 (2.5)
20 ～ 30	22	0
4 30 以上	17	0
5 不　明	2	0

6（ ）内は%

2） 年令との関係：表9にしめすように若年者に少なく高令者に多い傾向がみられるが，停年退職（55才）を目前にひかえて今後の生活不安を反映していると思われる．46～55才の群でやや少なくなっているのは，被災後5年を経過してすでに退職しているものが多いためであろうか．

表9 神経症と年令

1年　令（才）	2被検者（名）	3神経症者（名）
4 25 以下	43	1 (2.3)
26 ～ 35	201	8 (4.0)
36 ～ 45	262	21 (8.0)
46 ～ 55	165	11 (6.7)

5（ ）内は%

3. 訴えのみ

いろいろな自覚症状をもつが他覚的にはとらえがたいもの，CO中毒以外の疾患（例えば高血圧）による症状と思われるもの，あるいは単純な心気的訴えのものは，訴えのみとしてまとめた．検診結果ではこのような例がもっとも多く53.4％であった．

1） 訴えの内容：訴えの内容は多岐にわたっている．表10．頭痛・頭重（約43％），物忘れ（約26％），易疲労性（約14％），関節痛（約13％），不眠（約13％），めまい（約10％）などが比較的多く，その他に耳鳴り（9％），腰痛（7％），胃腸障害（6％），筋けいれん（主として腹筋のこむらがえりで5％），発汗過多（3％），インポテンツ（2％）などがあった．

2） 意識障害との関係：同じ表10にしめすように，物忘れは意識障害の時間に比例して多くなっている．意識障害が30時間以上のものでは少なくなっているのは，器質的障害が高度なために自ら訴えないからである．これとは対照的に，頭痛，易疲労性，関節痛，不眠，めまいなどの訴えは，意識障害時間の短いものや，なかったものに多い．

3） 年令との関係：訴えのなかではCO中毒と関係があると思われる物忘れについては年令との間に有意な関係はないが，訴えの絶数についてみると年令の増加とともに多くなっている（表11）．とくに頭痛・頭重，めまい，耳鳴りなどは加令とともに多くなっている．

4） 高血圧について：訴えのなかには，頭痛・頭重，めまい，耳鳴りなどのように高血圧によると思われるものが多い．また検診時の血圧測定の結果，高血圧（最高圧150mmHgまたは最低値90mmHg以上のもの）をしめすものが意外に多かった．そこでCO中毒者の被災前の血圧測定値と，災害に遭遇しなかった対照群の5年経過の前後における測定値を，鉱業所の健康診断の記録にもとづいて調査した．その結果が表12であるが，CO中

表10 自覚症状と意識障害時間

1意識障害（時）	2被検者（名）	3頭痛・頭重	4物忘れ	5易疲労性	6関節痛	7不　眠	8めまい
な　し	301	142 (47.2)	24 (8.0)	45 (15.0)	46 (15.3)	38 (12.6)	40 (13.3)
10 以下	224	98 (43.8)	63 (28.1)	33 (14.7)	28 (12.5)	34 (15.2)	19 (8.5)
10 ～ 20	105	44 (41.9)	66 (62.9)	11 (10.5)	10 (9.5)	9 (8.6)	9 (8.6)
20 ～ 30	22	5 (22.7)	14 (63.6)	2 (9.1)	1 (4.5)	3 (13.6)	0
30 以上	17	1 (5.9)	4 (23.5)	0	0	0	0
不　明	2	0	2	0	0	0	0
計	671	290 (43.2)	173 (25.8)	91 (13.6)	85 (12.7)	84 (12.5)	68 (10.1)

9（ ）内は%

表11 自覚症状と年令

年令	被検者(A)	頭痛	物忘れ	腰痛	関節痛	不眠	めまい	耳鳴り	その他	計(B)	B/A
25以下	43	9 (20.9)	12 (27.9)	8 (18.6)	4 (9.3)	6 (14.0)	3 (7.0)	4 (9.3)	22 (51.2)	68	1.6
26～35	201	78 (38.8)	59 (29.4)	37 (18.4)	18 (9.0)	14 (7.0)	16 (8.0)	10 (5.0)	122 (60.7)	354	1.8
36～45	262	111 (42.4)	67 (25.6)	36 (13.7)	37 (14.1)	40 (15.3)	29 (11.1)	25 (9.5)	162 (61.8)	507	1.9
46～55	165	92 (55.8)	35 (21.2)	10 (6.1)	26 (15.8)	24 (14.5)	21 (12.7)	24 (14.5)	110 (66.7)	342	2.1

（ ）内は%

表12 高血圧をしめしたもの ——対照群との比較——

	被検者	検診時に高血圧をしめしたもの	被災前に高血圧をしめしたもの	平均年令
CO被災群	671	143 (21.3%)	48/113*(41.8%)	41.7
対照群**	300	65 (21.7%)	28 (43.1%)	40.9

* 検診時に高血圧をしめしたもののうち，被災前（5年前）の血圧測定の記録のみつかったものは115名で，そのうち48名がすでに高血圧をしめしていた
** 対照群は42～43年と37～38年の測定記録によった

患群と対照群とのあいだに有意の差は認めなかった．

6. 被災場所と器質的障害

三川鉱の坑道配置はきわめて複雑であり，被災場所を簡単に分類することはむずかしい．鉱業所病院の資料[6]では被災場所は26に区分されているが，ここでは被災場所における死亡率を目やすにしておおまかに4群に分けた．I群は死亡率が50%以上，II群は25～50%，III群は25%以下，IV群は死亡者なしの場所である．この4群の被災者に器質的障害がどの程度に発生しているかをみたのが表13である．表にしめすように器質的障害の発生率は，死亡率が高く，したがってCO濃度も高かったと思われるI群（30.5%）よりも死亡率は低く，したがってCO濃度はI群よりも低かったと思われるII群において高い（53.7%）．これはI群が坑口に近く比較的早く救出されたのにたいして，II群は坑口より遠いために救出がおくれCOに長時間暴露されたためと考えられる．III群はI・II群に較べるとCOの流入が少なかったところである．IV群は爆発時の爆風によって一時的なCO流入が考えられるが，通常はI・II・III群とは別の経路から通気をうけており直ちに新鮮な空気におき換えられたところである．

表13 被災場所による器質的障害発生のちがい

被災場所	被検者	器質的障害をあらわしたもの
I	46	14 (30.4)
II	254	137 (53.9)
III	232	36 (15.5)
IV	139	2 (1.4)
計	671	189 (28.2)

（ ）内は%，説明本文

7. 職場復帰の状況

検診時における被災者の職場復帰の状況は表14にしめすように約70%である．検診対象者より退職者を除くと約77%である．このような職場復帰率は他の炭鉱災害によるCO中毒者のそれに比べるといちじるしく低い．例えば39年の山野鉱におけるガス爆発では，退職者を除くとCO中毒者のほぼ100%が41年7月までに職場に復帰している[1]．

表14 職場復帰状況

被検者の所属労組	坑内就労	坑外就労	計
新労（376名）	242 (64.4)	38 (10.1)	280 (74.5)
三労（232〃）	11 (4.7)	126 (54.3)	137 (59.1)
職組（ 34〃）	22 (64.7)	3 (8.8)	25 (73.5)
組夫（ 29〃）	23 (79.3)	0	23 (79.3)
計（671〃）	298 (44.4)	167 (24.9)	465 (69.3)*

* 退職者（67名）を除くと約77%となる　（ ）内は%

またこの職場復帰状況は，特定の労組に所属する被災者において低く，とくに坑内復帰についてはいちじるしい差があるのが注目された．

考　察

CO中毒による後遺症については，すでにおびただしい報告や多数の総説もあるので，ここでは今回の検診でとくに印象づけられた事項をとりあげる．

1. 他の集団発生したCO中毒との比較

三池災害では，器質的障害を残していると推測されるものが約28%であったが，これは他の集団発生したCO中毒による後遺症の発生率にくらべるといちじるしく高い．40年6月の山野鉱のガス爆発事故は，CO中毒によって237名（入坑者の43%）が即死するという死亡率からみると三池災害よりも大きい災害であったが，生存者のうち後遺症を残すものは7名（生存者の約2%）であった[13]．42年9月の三川鉱における再度の坑内火災では7名がCO中毒で死亡し300余名の被災者をだしたが，三池災害にみられるような後遺症を残していない[9]．

炭鉱災害ではないが，某工場における集団発生[3]では，6名が死亡し250余名がCO中毒者とされたが，事故後50日目において神経症を現わしていたものは1名（0.4%）であった．また，集団発生例ではないが，Shillito[12]が10年間におけるある地域に発生したCO中毒例について報告している．それによると，3分の1が死亡しているが，生存者のうち重篤な後遺症のために精神病院に入院したものは39例（0.2%）にすぎなかった．

勝木ら[7]は災害後2年を経過した時点で，山野鉱，夕張鉱，伊王島鉱における集団発生と比較して，三池災害がこれらの集団発生例より重篤な後遺症を多く残していることを報告している．また，症状がほぼ固定したと思われる3年半の時点で，立津ら[10]がおこなった562名の検診結果では，入院患者を除く比較的軽症者であったにもかかわらず，68.5%（立津らの報告の表4より算定）という高率に器質的障害をみとめている．もっとも，このうち約3分の1は生来性のものと推定されるので，それを除外すると約36%となる．今回の検診結果と立津らのそれといずれが事実をより正確に伝えているかは別として，いずれにしろ三池災害が他の集団発生したCO中毒にくらべてより多くの後遺症を残したことをしめすものであろう．

このように三池災害によるCO中毒では他に類をみない多数のしかも重篤な後遺症を発生したことについては，COが後遺症発生にとっての至適濃度であったことと救出完了の時間経過が長かったことが重要な要因として考えられるが，その他，爆発の種類，通気状況等の要因も考えられる．この問題については別に詳細に発表する[21]．

2. 間歇型について

日本におけるCO中毒後遺症の報告例について藤井[2]らがまとめたところによると，約半数が間歇型であったので，災害当時には多くの間歇型が現われるのではないかと危惧されたが，その発生は意外に少なかった．私の調査では freie Interval[11] をもつものは全体の約1%，意識障害のあったものについては約2%にすぎなかった．東家[19]は被検者93名中5例（約5%）に間歇型をみとめているが，このなかには従来記載されていない情意減弱を主症状とする特殊な型の2例をふくんでいる．三池医療委[7]が報告した比較的重症の51例の記録をみると（不詳な例はあらためて調査した），間歇型は4例（8%）である．しかし freie Interval こそないが，数日ないし数週をおいて症状の悪化のみられる不完全な間歇型とみられるものが7例（14%）にみとめられる．このような症例をみると，間歇型と非間歇型とはかならずしも截然と区別されうるものではないようにみえる．Pohlisch[16] がCO中毒の後期を unkomplizierte Weiterverlauf と komplizierte Weiterverlauf とに分け，Sibelius の間歇型を後者のなかの1つとして位置づけたことが思い出される．

3. 知的機能の障害

三池災害のCO中毒では知的機能の障害がもっとも多く後遺症の中心をなしていると思われた．知的障害には高度の痴呆から軽度の記憶障害にいたるさまざまな段階があるが，軽症者の記憶障害の特徴は，記憶の機構を記銘—保持—想起と分解してみた場合，保持能力の障害が強いように思われた．例えば数字の逆唱による記銘力テストは良好であっても，3億円強奪事件（43年末に世人をおどろかせた事件）やメキシコ・オリンピック（43年10月）については，あいまいな記憶や，指摘されてはじめておぼろげながら想起できるくらいにしか記憶されていない．またモーターバイクの免許取得のための法規の試験に，学歴などから推定して当然合格してよいと思われるのに，数回受験していずれも失敗するといったような例である．このような記憶障害をしめすものでも暗算のテストには迅速に正答することができるし，態度や応答の仕方は整っていることなどから，記憶障害はCO中毒によるものと判断せざるをえなかった．

軽度の器質的障害があるとみたものの大半は，このような新しい記憶の障害をしめすものであった．大まかにいえば，性格変化や失行・失認を含む神経学的異常をしめすものは，知的障害が中等度以上になってはじめて合併していると思われる．

4. 器質的障害と年令との関係

器質的障害と意識障害の時間とが相関関係にあることは容易にうなずけることである．しかしながら年令との

関係は常識的予測に反した結果がえられた．表7でしめしたように，器質的障害ありと思われたもののうち，軽度および中等度の障害と年令との間には有意な関係はみとめがたいが，高度の障害をしめすものは若年者に多く高令者に少なかった．これは表2にしめしたように，高令者は死亡率が高いということと裏腹の関係にあると思われる．高度の脳障害をうけたものは，高令者は死亡してしまうのにたいして，若年者は生存しえて高度の後遺症を残しているのである．

CO中毒後遺症の実験的研究[30]の結果，CO中毒下の動物が生きながらえる重要な要因は心肺機能の強弱であることが明らかにされた．心肺機能の強い動物ほどCO中毒下で長く生きながらえることができるし，したがって中毒後に重篤な後遺症を残すのにたいして，心肺機能の弱いものはCO中毒下で死亡しやすく，死戦期をかろうじて脱した動物でも後障害はまったくないかあるいは軽度であった．ヒトの場合でも高令者が若年者よりも心肺機能が弱いことが想像されるので，したがって死亡率は高いが生存しえたときの後遺症は若年者にみられるような重症例は少ないと考えられる．三池災害によって今なお臥床のままで発語がまったくなく，自発運動もほとんどみられない最重症の2例（熊本大学第1内科入院中）は，災害当時それぞれ21才と23才であった．

5. 神経症，その他の問題について

三池災害の被災者の神経症的傾向や心因的事項については，すでに安河内[15]や友成[19]が，三池の被災者が他の労災患者よりも経済的に有利な状態におかれており，したがって疾病利得的要因のはたらく余地が大きいことを指摘している．さらに，そのようになった背景には，三井三池鉱業所の特殊な労使関係があり，各労組による災害のうけとめ方のちがいが，神経症的症状形成や職場復帰率に差異をうんでいることも指摘されている．

今回の検診においては，CO中毒による器質的障害を想定しがたいもののなかで，明らかな神経症症状をあらわしているものと，CO中毒による症状とは考えがたい訴えをもつもの（このなかには多少の心気的傾向をもつものをふくむが，専門的医療の対象とはならないもの）とに区別した．

明らかな神経症は全体の約6％にみられたが，これを所属労組別にみると，新労，職組および組夫ではいずれも3％前後であったのにたいして，三労では12％とやや多かった．一方，なんらの訴えもなく他覚的にも所見のないものは，新労，職組および組夫では12～20％であったが，三労では1名もなく，すべてなんらかの身心故障の訴えをもっていた．しかし，三労所属のものにかぎらず，各労組とも訴えのみとしたものが圧倒的に多く，その自覚症状をCO中毒と結びつけて考えているものが多かったが，CO中毒にかんする医学的啓蒙の不足もかんじられる．また，被災者を「ガス患」と呼ぶような周囲の特別な眼があり，被災者の訴えをますます醸成している雰囲気もある．

災害のうけとめ方が各労組によって異なることは，職場復帰，とくに坑内復帰率の差に顕著にあらわれている（表14）．新労，職組および組夫においては65～80％の坑内復帰率をしめしているが，三労においては桁ちがいに低い．災害による死亡率は各労組とも31～34％とほぼ同率であったことを思えば，三労所属の被災者に坑内就労が困難な後遺症を多く残したとは考えがたい．

このような各労組間にみられる差は，災害医療の初期からすでにみとめられたところである．生存者945名中約89％（839名）がCO中毒と認定されたのであるが，各労組別の内わけをみると，新労，職組および組夫では生存者の69～85％がCO中毒と認定されたのにたいして，三労では生存者の100％が認定をうけている．

以上みてきたように，神経症の発生，訴えの有無，職場復帰についての所属労組別の差は，医学的条件からのみ生じたものではないことは明らかであり，三井三池鉱業所の特殊に実現化している労使関係と，災害に対処する各労組指導部のイデオロギーのちがいに起因するところが大きいと思われる．

しかしながら，このことは，三池災害の被災者が，他の労災患者と区別される特殊なものであることを意味するものではない．むしろ，他の労働災害の個々の被災者に存在するいろんな矛盾が，三池災害においては集団化され，組織化されたことによって，その本質により迫るかたちで問題が提起されることとなったのである．

この項にかんしては，別に詳しく論及する予定である．

ま と め

1. 三池災害によるCO中毒者の被災後満5年における実態を把握するために検診をおこない約81％（671名）の検診率をえた．

2. 器質的障害をもつものは約28％と推測されたが，そのうち知的障害をしめすものがもっとも多く約25％，性格変化は約12％，神経学的異常は約8％，自律神経

害は約4%にみられた．これらの障害は合併してあらわれているものが多い．

三池災害によるCO中毒後遺症の発生は他の集団発生例より高率であり，集団発生のCO中毒を一律に論ずることはできない．

3. 器質的障害をあらわすものは被災時の意識障害時間と明らかな相関をしめしていた．年令とのあいだには明瞭な関係はないが，高度の障害にかかると若年者に多いことが注目された．

4. 被災場所別に器質的障害の発生率をみると，死亡率が50%以上でCOも高濃度であったところよりも，死亡率が25～50%でCO濃度も前者より低かった場所で高率であった．この差異は，CO中毒後遺症の発生が一定濃度のCOとそれに暴露される時間経過によるものであることを示す．

5. 間歇型は全体の約1%にみられたにすぎないが，比較的重症例には不完全な間歇型があり，間歇・非間歇は截然とは区別しがたいもののあることを指摘した．

6. はっきりした神経症は全体の約6%，身心故障の訴えのみのものは約53%，異常のないものは約12%であった．

7. 被災者の職場復帰にはその所属労組別にいちじるしい差のあることをしめしたが，この問題の解明には，医学的事項をふまえた上での社会科学的接近が必要である．

ご指導とご校閲をいただいた安河内五郎所長にお礼を申し上げます．また検診にあたり次の方々にご協力をいただいたことに感謝します．

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